Escola Universitária Vasco da Gama

Master´s Degree

Urinary Incontinence In Bitches After Ovariohysterectomy

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Coimbra, July 2015

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Abstract

Urinary incontinence (UI) can be defined as the lack of voluntary control over the flow of urine during the storage phase, resulting on leakage of urine when there is no intention to urinate.

This urological disorder seems to affect particularly bitches, and among those, the neutered bitches appear at an increased risk. Several aetiologies have been proposed to explain the UI in ovariohysterectomized bitches, such as urethral sphincter mechanism incompetence, decreased urethral tone, caudal bladder position, shorter urethra, hormonal deficiency, timing of neutering relative to onset of puberty, docking and even obesity, however the exact mechanism of pathogenesis is still unknown.

Considering that the etiology of UI among ovariohysterectomized bitches remain controversial, and as it is prevalent in 5 to 20% of neutered bitches, it was performed a retrospective study that involved 45 neutered bitches with UI, in order to investigate the contribution of age, weight, breed, environment, type of fur, previous pregnancies, among others, to the occurrence of UI. For that purpose a questionnaire was made, directed to the owners of female incontinent dogs after spay, to evaluate the contribution of the mentioned factors in to the urinary incontinence.

In this study, 28% (n=13) of the involved bitches was sterilized between 6 months an 1 year old, 37% (n=17) weight between 10 and 20kg at the time of ovariohysterectomy, 42% (n=19) suffers a weight gain more than 3kg since ovariohysterectomy, 44% (n= 20) showed signs of UI until 3 years old, 46% (n=21) weight between 20 and 30kg at the time of UI and 71% (n=32) lasted two years until UI appeared. A positive statistics correlation was found between age at UI with previous pregnancies and UI state with UI occurrence. A positive correlation was also found between urinary incontinence gravity and UI time of day ($p<0.05$), as well as UI gravity and UI frequency ($p<0.01$). The results did not show a correlation between ovariohysterectomy weight and UI age ($p=0.15$), UI weight and UI age ($p=0.47$), weight gain since ovariohysterectomy and age at UI ($p=0.62$).

There are some factors that can influence the UI after spay, but further studies are need, since this issue still keeps quite controversial among the various authors.

Keywords : Bitches; Hormonal deficiency; Ovariohysterectomy; Urinary incontinence; Urethral sphincter mechanism incompetence.

Resumo

A incontinência urinária (IU) pode ser definida como a falta de controlo voluntario sobre o fluxo de urina durante a sua fase de armazenamento, resultando assim no vazamento de urina quando não há intenção de urinar.

Esta patologia urológica parece afetar particularmente cadelas, sendo que as cadelas esterilizadas parecem estar em maior risco. São várias as etiologias propostas para explicar a IU em cadelas ovariohisterectomizadas como: mecanismo da incompetência do esfíncter uretral, diminuição do tónus uretral, posição caudal da bexiga, uretra curta, deficiência hormonal, altura da esterilização relativamente á altura da puberdade da cadela, corte de cauda e até mesmo a obesidade, mas, no entanto, o mecanismo exato da patofisiologia é desconhecido.

Considerando que a etiologia da IU entre as cadelas ovariohisterectomizadas é controverso, e que a sua prevalência encontra-se entre 5 e 20%, foi realizado um estudo retrospetivo com 45 cadelas esterilizadas com IU, com o objetivo de investigar a contribuição da idade, peso, raça, ambiente, tipo de pelo, gestações, entre outros, para a ocorrência de IU. Para tal, foi realizado um questionário direcionado a proprietários de cadelas incontinentes após a ovariohisterectomia, no sentido de avaliar a contribuição dos fatores previamente mencionados na incontinência urinária.

Neste estudo, 28% (n=13) das cadelas foram esterilizadas entre os 6 meses e 1 ano de idade, 375 (n=17) pesavam entre 10 e 20kg na altura da ovariohisterectomia, 42% (n=19) sofria de aumento de peso em mais de 3kg desde a esterilização, 44% (n=20) demonstrou os primeiros sinais de IU até aos 3 anos de idade, 46% (n=21) pesava entre 20 e 30 kg no momento da IU e em 71% (n=32) a IU desenvolveu-se após 2 anos da ovariohisterectomia.

Uma correlação estatisticamente positiva foi encontrada entre a idade de IU e as gestações, entre o estado de excitabilidade em que a cadela se encontra no momento de IU e a altura em que ocorre a incontinência. Outra correlação positiva foi encontrada entre a gravidade da incontinência e a altura do dia em que a IU ocorre ($p<0.05$), assim como entre a gravidade da incontinência e a frequência da IU ($p<0,01$).

Os resultados não demonstraram nenhuma correlação estatisticamente positiva entre o peso no momento da ovariohisterectomia e a idade em que a cadela ficou incontinente ($p=0,15$), entre o peso no momento em que ficou incontinente e a idade em que manifestou sinais de IU ($p=0,47$), entre o aumento de peso desde a esterilização e a idade em que ficou incontinente $p=0,62$).

Existem alguns fatores que podem influenciar a UI após esterilização, no entanto mais estudos necessitam de ser realizados mais estudos adicionais, uma vez que este ainda é um assunto bastante controverso entre os diversos autores.

Palavras-chave: Cadelas; Deficiência Hormonal; Incontinência Urinária; Mecanismo de Incompetência do Esfíncter Uretral; Ovariohisterectomia.

Acknowledgements

“Gostaria de agradecer às minhas orientadoras, Prof.Dra. Anália Carmo e Dra. Sónia Miranda por aceitarem este projeto e por me orientarem ao longo deste processo assim por toda a disponibilidade e ajuda que me prestaram durante o período de estágio e redacção desta Tese de Mestrado;

Ao Prof. Dr. Nuno Carolino por toda a ajuda e apoio, principalmente durante o processo de análise estatística desta tese;

A toda a equipa do Centro Veterinário Conimbricense por me terem acolhido por 3 meses durante o meu estágio curricular e por todo o apoio, disponibilidade, dedicação, transmissão de conhecimentos e amizade que demonstraram;

À minha família, amigos e namorado por sempre acreditarem em mim, por todo o carinho, paciência e apoio;

A todos os meus professores ao longo do curso, por serem uma fonte de inspiração, por todo o apoio e por me terem transmitido os seus conhecimentos;

À Escola Universitária Vasco da Gama por me proporcionar as condições necessárias para que esta Tese de Mestrado fosse realizada;

A todos vocês o meu sincero e profundo agradecimento”

“To my parents and grandparents…”

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List of Abbreviations

FSH – Follicle stimulating Hormone
LH - Luteinizing hormone
OVH – Ovariohysterectomy
PNS – Periferic Nervous System
PD- Polyuria
PU- Polydipsia
UI- Urinary Incontinence
USMI – Urethral Sphincter Mechanism Incompetence

1. Introduction

Urinary incompetence (UI) can be defined as the lack of voluntary control over the flow of urine during the storage phase, resulting on urine leakage when there is no intention to urinate (Ponglowhapan, Khalid, & Church, 2012).

Micturition disorders can be divided into two groups: neurogenic origin and non-neurogenic origin. Neurogenic disorders are the ones that include all types of neurogenic lesions that can cause a lost of voluntary control of the bladder, including discospondylitis, medullary lesions, spina bifída, paraplegia, among others (figure 1). Micturition disorders of non-neurogenic origin include urethral sphincter mechanism incompetence (USMI), detrusor overactivity (or urge incontinence), and anatomical or functional urethral obstruction that may lead to secondary bladder atony, ectopic ureters, neoplasia, intersexuality and bladder atony due to muscle weakness or medications (Figure 1) (Sam & Craig, 2000, Noël *et al*., 2010, Ponglowhapan *et al*., 2012).

Some studies pointed that USMI is in fact, one the main causes of UI and that there is a racial predisposition to USMI. These studies reported that Boxer, German Shepherds, Doberman Pinscher, Old English Sheepdog, Bouvier des Flanders, Dachshund, Irish setter, Rottweiler and Weimaraner seem to have an higher risk to develop USMI (Verde & Crivellenti, 1999, DeRossi Rafael, 2003, McLoughlin & Chew, 2009, Ponglowhapan *et al*, 2012).

Nevertheless, USMI may also occur due to other causes, such as decreased urethral tone, caudal bladder position, a shorter urethra, hormonal deficiency, docking, obesity, neutering and timing of neutering relative to onset of puberty (Gregory, 1994, Claeys *et al.*, 2011; Reichler & Hubler, 2014).

Confirming the fact that USMI is one of the main causes of UI (Bacon, Oni, & White, 2002, S. Ponglowhapan, Church, Scaramuzzi, & Khalid, 2007, Stenchever, 1986), the study performed by Noël *et al* (Noël *et al*., 2010) showed that 61% of UI among female and male dogs were due to USMI. In addition, other studies pointed that among female dogs the higher incidence of USMI was in females submitted to ovariohysterectomy (OVH) (5 -20%), indicating that this surgical procedure was a risk factor for UI (Holt & Muirhead, 1998; Spain, Scarlett, & Houpt, 2004; Arnold, Hubler, & Reichler, 2008; Forsee *et al*., 2008; Michael Thrusfield, 2011; Beauvais *et al.*, 2012; Reichler & Hubler, 2014,). UI in spayed bitches may occur virtually immediately after sterilization or in a matter of months or years after the surgery (Arnold, Hubler, & Reichler, 2008), but usually, it occurs 2-3 years after the surgery (, Holt, 1985a; Arnold *et al* , 1989a; Kustritz, 2002; Angioletti *et al*., 2004; Sanborn, 2007; Noël, Claeys, & Hamaide, 2010).

Although there is a consensus regarding the contribution of sterilization to UI, it is not known if the moment at which sterilization occurs may or may not be decisive for the development of UI (Spain, Scarlett, & Houpt, 2004). In a previous study, Beauvais et al. (Beauvais *et al*., 2012) pointed that there is not a strong evidence regarding the association between the age of spay and the development of UI.

On the other hand, Chew (Chew, 2013) stated that in dogs spayed before their first estrus the incidence of UI was 9.7% as compared to 1% incidence previously determined in not sterilized female dogs (Coit, Gibson, Evans, & Dowell, 2008). Furthermore, Chew (Chew, 2013) pointed that female dogs neutered before 3 months of age had twice the risk to develop UI in contrast with female dogs neutered after 3 months of age.

Another controversial subject is the correlation between the surgical technique and the possible development of USMI and consequently of UI. Several studies, pointed that due the surgical (ovariectomy or ovariohysterectomy) procedure, the impairment of the urethra closure may occur determining the development of UI (Rosin and Barsanti 1981; Arnold, Hubler, & Reichler, 2009). However, in a recent retrospective study it was reported that the incidence of UI was not dependent on the spaying technique (Reichler & Hubler, 2014). Altogether, these results put in evidence that there is some controversy regarding the association of age at spay, surgical technique and the development of UI.

As a consequence of UI, several bitches present constant or intermittently dripping of urine and their hind limbs are frequently wet with urine or saliva due a constant licking. For this reason, these animals may develop dermatitis, irritation and ulceration of the perineal area, and present a constant and unpleasant odour of urine that requires a daily care, being very frustrating for the owner (Anderson, 2001; Ponglowhapan *et al*., 2012; Connery & Spotswood, 2012).

Therefore, considering that UI may have several etiologies, being ovariohysterectomy one of the causes; that there is no consensus regarding the association of UI and time to perform surgical spaying; that spaying is a frequent procedure among females dogs and that animals presenting UI are at risk to develop other pathologies, it is important to understand the association between UI and several factors such as age, breed, and age of spaying.

For that purpose, a retrospective study was made in order to evaluate the contribution of several factors such as breed, weight, age of spaying to IU.

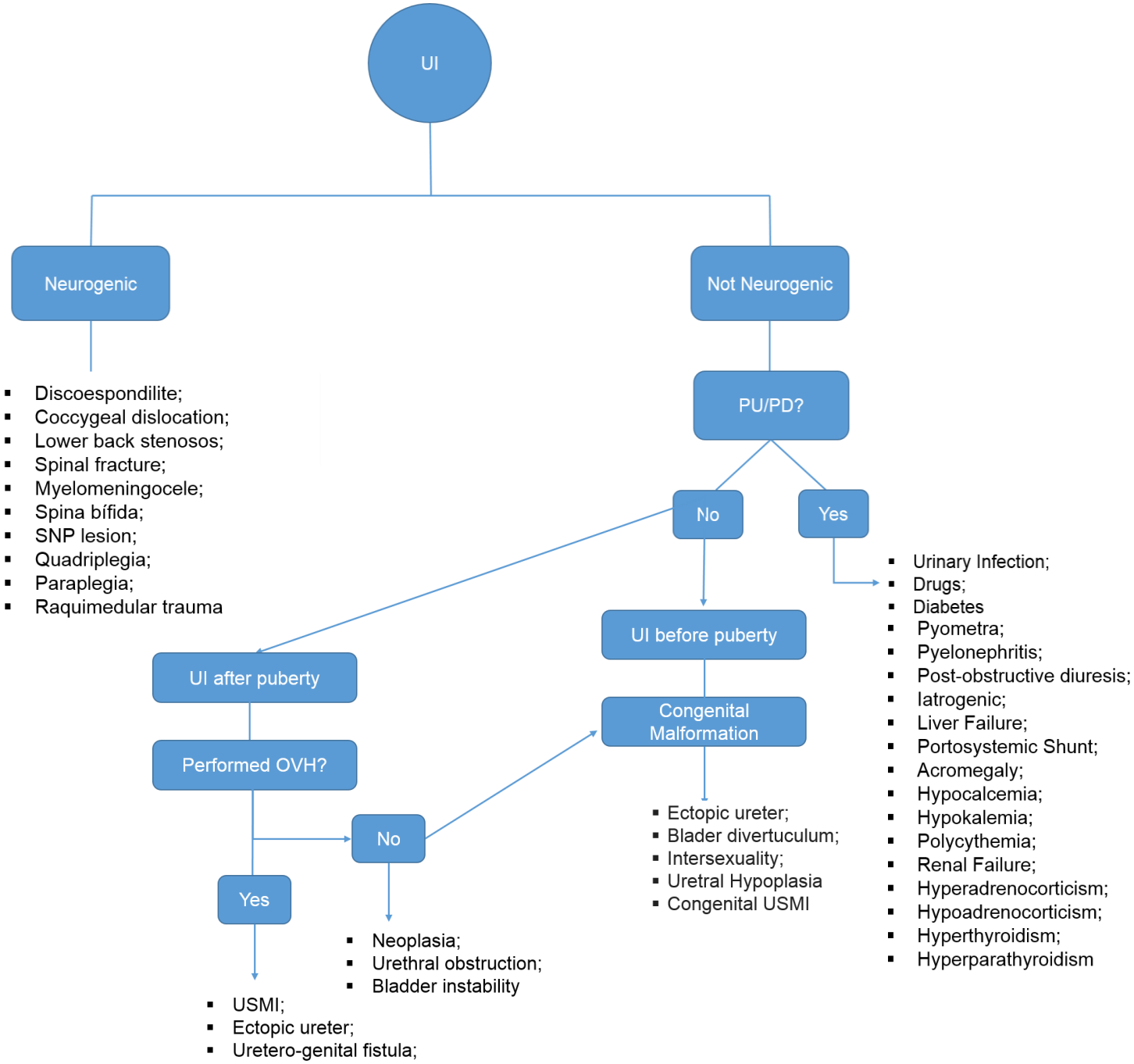

Figure 1 – Scheme featuring multiple etiologis of urinary incontinence.

2. Materials and Methods

This study intent to evaluate the influence of several components such as race, tail docking, age and weight before, after and at the time of spaying, surrounding environment, type of hair, age at first estrus and existence of previous pregnancies to the UI severity, frequency, time of day and age.

A literature review was performed using search engines such as PubMed, Science Direct and IVIS. The keywords “urinary incontinence”, “bitches”, “USMI“ and “neutering” were used.

According the web research, a closed format questionnaire based on 24 multiple choice questions, covering the above mentioned variables was elaborated (Annex). The questionnaire was carried out using Google forms and then it was sent via email, to several clinics and veterinary hospitals located throughout the country in order to be answered by veterinarians responsible for incontinent female dogs after ovariohysterectomy or by the owners of those dogs.

The questionnaire was available on a virtual platform, during a month and a half and 48 answered questionnaires were collected.

The main variables evaluated on the questionnaire were: UI frequency, occurrence, state, scale/gravity, treatment, time of day and age at UI. Regarding frequency of UI it was investigated how many times the UI was observed: several times a day, one time a day, every other day, one time a week or one time a month. The questionnaire also analyzed if the UI occurred during activity, rest or both and if at the moment of the UI, the female was excited, submissive or both. The gravity of the UI was classified according a scale from 1 to 5 (1 being a very light incontinence whit less milliliters of urine lost and 5 ta severe incontinence whit a big quantity of milliliters of urine lost). In the questionnaire it was also evaluated if the UI occurred at a particular time of the day: during the day, night or both.

Female dogs with other urinary abnormalities, including having UI before the ovariohysterectomy or urinary tract infection were not included in this study, therefore from 48 collected questionnaires, 3 were excluded due UI prior to sterilization.

2.1- Statistical analysis

Statistical analysis was performed using software Excel (Microsoft Excel 2013) and later worked, beginning with separate the sample dogs by size, using the scale small, medium, large and giant. After separation, data was analysed using SAS PROC FREQ (SAS Institute, 2004).

Several tests of independence with Chi-square test assessed association between variables (UI frequency, UI occurrence, time of UI, UI state, UI scale, UI treatment and age at UI) and several factors, including size, fur, age, weight, tail docking, environment, first heat, UI before OVH, previous pathologies, age at OVH, weight at OVH, weight gain since OVH to UI, time until UI, weight at UI, pregnancies, OVH before or after first heat and number of estric cycles.

3. Results

Forty five questionnaires were collected in our retrospective study. As previous referred the data collected during the study were analysed in order to determine the correlation between several factors (size, age, breed, type of fur, tail docking, weight, environment, 1st heat, previous pathologies, age at OVH, weight at OVH, weight gain since OVH to UI, time until UI, weight at UI, pregnancies, OVH before or after 1st heat and number of estric cycles) and the following variables: UI frequency, UI occurrence, UI state, UI scale/gravity, treatment, UI time of day and age at UI.

3.1 - Characteristics of the envolved population

The data from questionnaires was organised according the table presented in the annex. Each characteristic was analysed and then it was evaluated the correlation between different characteristics.

3.1.1– Breed characterization

Since previous studies pointed that UI was more prevalent in some breeds, the collected data was organized according to breeds (table 1). From the 45 females of the study, 26.66%, (n=12) were Labradors and 28.8% (n=13) were from mixed-breeds. The remaining females (44.5%) were Yorkshires (8.9%, n=4), Boxers (4.4%, n=2), the Cocker spaniel (4.4%, n=2), Jacky Russek (4.4%, n=2), Pug (4.4%, n=2). The remaining 18% belonged to isolated breeds and were organised for statistical analyse purposes, into two groups according to their size (figure 1). In Group A (11.1%, n=5) were included large breeds, including a Newfoundland, an Irish Setter, a Rhodesian Ridgeback, a Doberman and a Fila S. Miguel and in Group B (6.6%, n=3) were included a Samoyedo, a French Bulldog and a Sharpei.

Table 1- Characterization of the data according the breed

Breed	n=	Age OVH	Weight OVH	Time until UI	Weight IU	Age at 1st heat	Weight gaine since OVH
Mixed-breed	12	0-6 months to ≥6 years	1-10kg to 20-30kg	0-2 years to ≥6 years	1-10kg to 20-30kg	Never to 12-13 months	0-2kg to ≥5kg
Labradors	13	0-6 months to ≥6 years	10-20kg to ≥ 30kg	0-2 years to 3-6 years	20-30kg to 30-40kg	Never to 8-9 months	0-2kg to ≥5kg
Yorkshire	4	7 months -1 year to ≥6 years	1-10kg	0-2 years	1-10kg	Never to 8-9 months	0-2kg to 2-3kg
Boxer	2	0-6 months and ≥6 years	10-20kg and 20-30kg	0-2 years	20-30kg	6-7 months	0kg to ≥5kg
Cocker Spaniel	2	3-6 years and ≥6 years	10-20kg and 20-30kg	0-2 years and 3-6 years	10-20kg and 20-30kg	6-7 months	2-3kg
Jack Russel	2	7 months - 1 year and 1-2 years	1-10kg	0-2 years	1-10kg	Never and 6-7 months	2-3kg and ≥5kg
Pug	2	7 months - 1 year and 3-6 years	1-10kg	0-2 years	1-10kg	Never and 6-7 months	0-2kg
Group A*	5	0-6 months to 3-6 years	10-20kg to ≥ 30kg	0-2 years	20-30kg to 30-40kg	Never to 8-9 months	0kg to ≥5kg
Group B**	3	0-6 months to 1-2 years	1-10kg to 20-30 kg	0-2 years to ≥6 years	10-20kg to 20-30kg	Never to 8-9 months	0kg to 2-3kg

* - Group of isolated large sized breeds, including a Newfoundland, a Irish Seter , Rhodesian Ridgeback, a Doberman and a Fila S.Miguel.

** - Group of isolated medium sized breeds, including a Samoyedo a French Bulldog and a Sharpei.

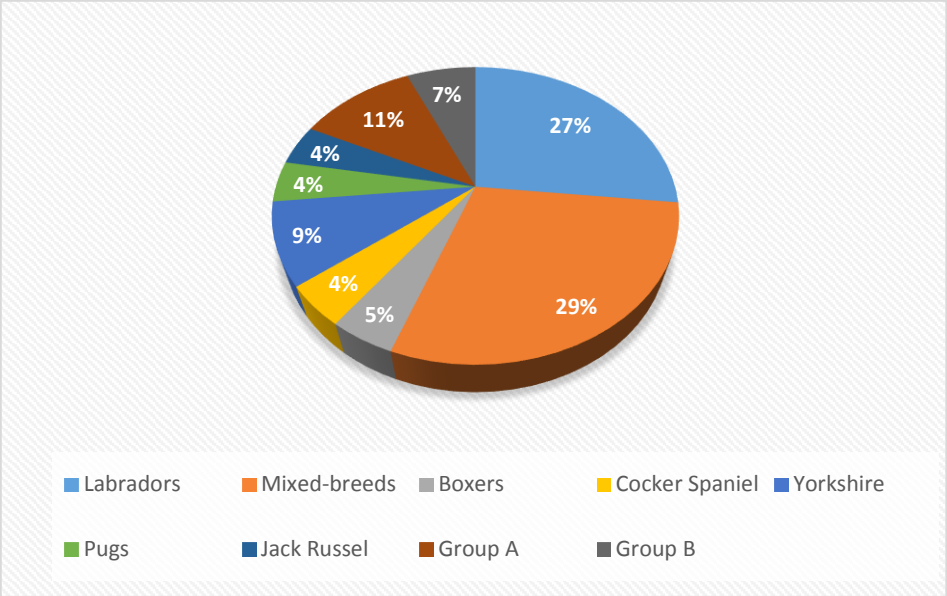

Figure 2 – Characterization of the female population regarding breeds

3.1.2 - Age characterization

About 69 % (n=31) of the females with UI in this study were aged bitches (equal or older than 5 years), 20% (n=9) were aged between 3-4 years and 11 % (n=5) were younger bitches with age up to 2 years.

In addition to the age of the females at the moment of the study, were also determined the age of the beginning of the UI, of the first heat, of the sterilization and calculate the time interval between the sterilization and the beginning of UI.

The analysis of the data (table 2) showed that 44 % of dogs began to show signs of IU up to 3 years old (n=20), 37.7% show signs of UI between 3 and 8 years (n=17) and 17.7% started to present UI signs above the 8 years old (n=8).

Previous studies also pointed that the age of the first heat could be associated to the development of UI. In this study 35.5 % (n=16), of incontinent bitches have had their 1st heat at 6-7 months of age 33.3% (n=15) never had heat and 31.1% (n=14) had their first heat between 8 and 9 months.

In the questionnaire was investigated the age of the surgical procedure and also the time, after surgery, the females presented UI. The analysis of the data showed that nearly 30% of the females have been sterilized between 6 months and 1 year age (n=13), 26.6% was sterilized between 1 and 6 years (n=12), 22.2% until 5 months of age (n=10) and 22.2% more than 6 years (n=10). Almost 71% became incontinent 2 years after sterilization (n=32), 20% between 3 and 6 years after surgery (n=9) and almost 9% take more than 6 years until show signs of incontinence, table 2.

Table 2 – Age population characterization

Age at the moment of the study	Time interval	n	%
Age at UI	0-3 years 3-8 years More than 8 years	20 17 8	44.4% 37.7 % 17.7%
1st heat age	6-7 months 8-9 months Never had heat	16 14 15	35.5% 31.1% 33.3%
Age at OVH	0-5 months 6 months-1 year 1-6 years More than 6 years	10 13 12 10	22.2% 28.8% 26.6% 22.2%
Time interval between the sterilization and the beginning of UI	0-2 years 3-6 years More than 6 years	32 9 4	71.1% 20% 8.9%

3.1.3 – Analysis of female weight data

The female population of dogs were organized as large (25-40kg), medium (10-25kg) and small (1-10kg) according their weight. As described in table 3, 44.4% of the sample was composed by large female dogs (n=20), followed by medium size female dogs with 33.3% (n=15) and then small bitches with 22.2% (n=10).

Regarding the weight at the moment of the onset of UI signs, 46.6% of the bitches weighted between 20 and 30 kg (n=21), 22.2% weighted between 1 and 10 kg (n=10), 15.5% weighted between 10 and 20 kg (n=7) and between (n=7) weighted between 30 and 40kg

It was also evaluated the weight at the moment of sterilization. In 37.7% of the females the weight at the time of the sterilization varied between 10 and 20kg (n=17), in 31.1% the weight varied between 20 and 30 kg (n=14), in 26.6% the weight varied between 1 and 10 kg (n=12) and in 4.4 % had the weight was above 30 kg.

In addition the female weight was also correlated with the breed, table 4.

Table 3 — Breed and weight characterization according to bitches size

	Small (1-10kg)	**Medium (10-25kg)**	**Large (25-40 kg)**
n	10	15	20
%	22.2%	33.3%	44.4%
Breed	4 Yorkshires 2 Pugs 2 Jack Russel 2 Mixed-Breeds	6 Mixed-Breeds 3 Labradors 3 Group B 2 Cocker Spaniel 1 Boxer	9 Labradors 5 Mixed-Breeds 5 Group A 1 Boxer

Table 4 – Weight population characterization

	Weight interval	**n**	**%**
Weight at OVH	1-10kg 10-20kg 20-30kg More than 30kg	12 17 14 2	26.6% 37.7% 31.1% 4.4%
Weight gain since OVH	1-3kg More than 3kg 0kg	14 19 12	31.1% 42.2% 26.7%
Weight at UI	1-10kg 10-20kg 20-30kg 30-40kg	10 7 21 7	22.2% 15.5% 46.6% 15.5%

3.2- Analysis of the influence between factors and variables

In order to determine which factors may contribute to UI it was evaluated the relationship between the factors and variables, previously mentioned.

Positive correlations were found between several factors (Table 5): current age and age at UI ($p=0,01$), current age and UI time of day ($p=0.04$), age at OVH and age at UI ($p <0.01$), time until UI and age at UI ($p <0.01$), previous pregnancies and age at UI ($p <0.01$), number of estric cycles and age at UI ($p <0.01$), UI state and UI time of day ($p=0.01$), UI scale and UI state ($p=0.02$), age at UI and UI state ($p=0.01$) and UI state and UI occurrence ($p <0.01$).

Table 5. Positive correlations and their significance before Fisher analysis

Positive correlations	Value of the significance (P)
Current age and age at UI	0.01
Current age and UI time of day	0.04
Age at OVH and age at UI	<0.01
Time until UI and age at UI	<0.01
Previous pregnancies and age at UI	<0.01
Number of estric cycles and age at UI	<0.01
UI state and UI time of day	0.01
UI scale and UI state	0.02
Age at UI and UI state	0.01
UI state and UI occurrence	<0.01

A Fisher test was made to certify the veracity of these results (Table 6). The Fisher test showed that only 2 of these correlations were really dependent:

- Age at UI with previous pregnancies (Figure 3),
- UI state with UI occurrence (Figure 4).

Table 6 – Fisher´s Independence test results

Variables from contingency table	Value of the significance (P)
Age at UI (0-3 and 3-8) * pregnancies (no and yes)	0.0142
Age at UI (0-3 and more than 8) * pregnancies (no and yes)	<.0001
UI State (Excited and both) * UI Occurrence (activity and rest)	0.0067
UI State (Excited and Submissive) * UI Occurrence (activity and rest)	0.0070

3.2.1– Influence of previous pregnancies in the age at which UI

The results show that female dogs that were not pregnant before the OVH, had UI earlier, than bitches that had been pregnant at least one time (Figure 3). Also show that 57% of bitches that had never been pregnant became incontinent until 3 years of age (n=20), 34% between became incontinent between 3 and 8 years (n=12) and 8% become incontinent whit more than 8 years (n=3). Regarding the bitches that have been pregnant, 50% became incontinent at the age between 3 and 8 years (n=5) and the other 50% became incontinent with more than 8 years (n=5).

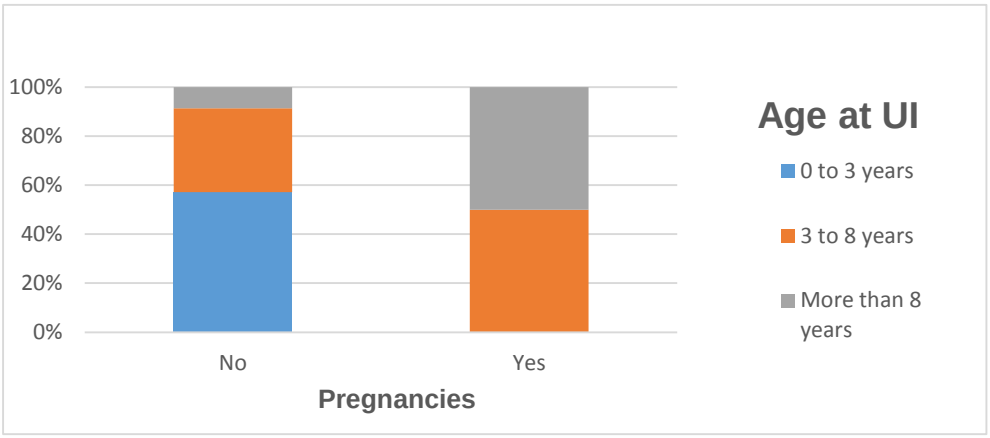

Figure 3 – Correlation between previous pregnancies and the age at which UI was detected

3.2.2- Influence of the UI state in the UI occurrence

The results shown in Figure 4, demonstrated that the majority of the bitches were incontinent in moments of excitability and of activity (66%). Only 17% of the bitches were incontinent at rest or a both moments (rest and activity). When the incontinence occurs ether in moments of excitability or in submissive moment, it's normally in rest times that this pathology is manifested (68%).

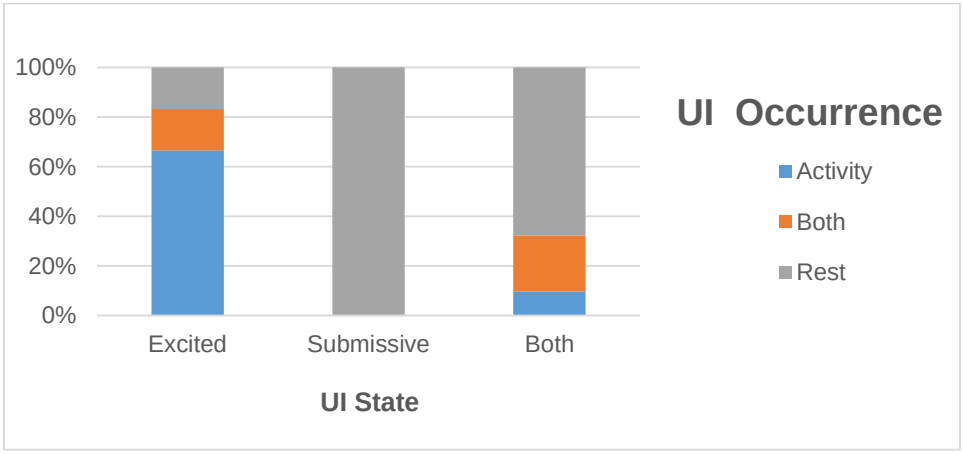

Figure 4 - Influence of UI State in the UI occurrence

In addition to the Fisher analysis it was also performed an analysis according the PROC GLM of SAS. According this analysis it was identified two positive correlation: between UI Scale and UI time of day ($p<0.05$), and between UI scale and UI frequency ($p<0.01$), as represented on Table 7 and Table 8 respectively.

3.2.3 – The influence of UI time of day with UI scale

The results showed that the scale of the UI was more severe when the bitches present incontinence during day and night times, as compared to that observed during the day and night. Although the incontinence has been considered more severe during the night than during the day, the statistical comparison between the severity during the day and night, was not significant, Table 7.

Table 7 – Minimum square average ± Standard error of UI Scale acording to UI Time of Day

UI Time of Day	UI Scale
Both	3.04 ±0.19
Day	2.08±0.38
Night	2.25±0.27

3.2.4– The influence of UI frequency with UI scale

The results showed that the UI severity was considered worse when the bitches presented incontinence every other day (1.08 in a scale of 1 to 5) and less severe when it occurred one time a month (3.17 in a scale of 1 to 5).

Table 8 - Minimum square average ± Standard error from UI Scale according to UI Frequency

UI Frequency	UI Scale
One time a day	2.89±0.31
One time a month	1.08±0.38
One time a week	2.31±0.57
Every other day	3.17±0.32
Several times a day	2.84±0.21

No correlation was found between OVH weight and UI age (p=0.15), UI weight and UI age (p=0.47), weight gain since OVH and age at UI (p=0.62). There were correlations that not being statistically significant put in evidence a possible tendency, such as: correlation between first heat age and UI age (p=0.08), environment and UI age (p=0.07), OVH before or after the first heat and age at UI (p=0.07) and current age and UI state (p=0.06).

4. Discussion

UI is a disorder that may affect 20% of the sterilized female dogs. The aetiology of the UI after OVH is still very controversial among authors. It is known that after ovariectomy, urethral closure pressure decreases, even in bitches that remain continent. However urethral closure pressure is reduced significantly in bitches with USMI (Donovan *et al*, 2014). Urethral closure pressure is normally maintained by sympathetic activation of alfa 1-adrenoreceptors in the urethral smooth muscle (Donovan *et al*., 2014) and after sterilization, a decrease in smooth muscle is observed in both bladder and urethra (Ponglowhapan *et al*., 2008[a], Noël, Claeys, & Hamaide, 2010b). A study performed by Coit (Coit et al., 2008) demonstrated that neutered bitches presented an increased percentage in collagen within the bladder wall, and a concomitant decrease in the proportion of smooth muscle relative to entire bitches. However, not all observations can be explained by oestrogen deficiency as being the only underlying cause of post-spay UI (Ponglowhapan et al., 2012).

It is known that bitches treated with long acting gestagens, had no increased risk for urinary incontinence, although this treatment lead to suppressed ovarian function and basal level of serum estradiol concentration (Arnold et al., 2009). In addition, the daily supplementation of oestrogen for incontinend biches only results in 61–65% of success to becoming continent again (Arnold et al., 2009). A study was designed based on the working hypothesis that the permanent elevation of gonadotrophins in the ovariectomized dog may cause UI and that suppression of FSH and LH levels might control this condition (Reichler et al., 2003).

The study concluded that ovariectomy induced an elevation in the circulating concentrations of pituitary LH because there is no gonadal negative feedback. Since LH receptors are present throughout the canine urinary tract it has been postulated that elevated gonadotropins may contribute to the development of USMI (Donovan *et al*., 2014).

In addition to the discussion regarding the UI etiology, there is also some controversy regarding the factors that may influence the development of UI after sterilization. Previous studies identified several variables (breed, weight before and after the sterilization, age at the first heat, age at sterilization) that may be involved in the pathophysiology of this disorder but the results are contradictory regarding the contribution of each variable (Thrusfield, Holt & Muirhead, 1998; Coit *et al*., 2008 ; Forsee *et al*., 2008; Ponglowhapan *et al*., 2012; Beauvais et al., 2012; Chew, 2013 ; Reichler & Hubler, 2014).

Regarding our study, it is important to consider that it was a retrospective study based on a questionnaire that it was given to veterinarians and also to the owners of incontinent bitches. In spite of the fact that the questionnaire was based on closed format questions, some of the answers were dependent on the opinion and also on the memory of the owners which may have influenced the results. Nevertheless, it is important to emphasize that the questionnaire was randomly distributed to clinics in order to ensure a significant and representative sample.

The analysis of the answers revealed that 44.4% of the UI were observed in larger females weighing between 25 and 40kg. This observation is in agreement with most of the studies that

claim that large bitches are more likely to develop USMI than small-sized bitches (Holt, 1985; Holt and Thrusfield, 1993; Thrusfield, Holt, & Muirhead, 1998; Forsee *et al*., 2008; Adin, 2011; Ponglowhapan *et al*., 2012; Muraro & White, 2014).

Regarding breeds, our results pointed that the mixed-breeds are the ones with the highest prevalence (29%) of IU, followed by Labrador Retrievers that had a prevalence of 26.6%. The high incidence in Labradors may just be a consequence of the fact that this breed is one of the main favorite breed in our country. To support this later hypothesis there are several studies pointing that unlike other breeds (Boxer, German Shepherd, Doberman Pinscher, Old English Sheepdog, Bouvier des Flanders, Dachshund, Irish setter, Rottweiler and Weimaraner), Labradors do not have an increased risk of contracting USMI (Gregory, 1994; Gregory, 1994; DeRossi Rafael, 2003; de Bleser, Brodbelt, Gregory, & Martinez, 2011; Ponglowhapan *et al.*, 2012) . There is no studies referring the predisposition of mixed-breeds to IU. Once this observation may be associated to the increased number of mixed-breeds in our study.

The tail docking was one the factors described as being associated to IU since the cut of the tail may injure the muscle of *ani levator* and may induce a coccygeus atrophy or damage (both muscles are equivalent to pelvic floor muscles) , (Gregory, 1994;de Bleser, Brodbelt, Gregory, & Martinez, 2011;Ponglowhapan et al., 2012). In our study 80% of the bitches had not performed tail docking indicating that tail docking is not determinant to the occurrence of UI.

The environment in which the bitches live daily, it was also a factor that according previous studies may influence the development of UI. We found that 53.3% of the incontinent bitches lived in home interior. It is important to consider that the information regarding this point is based on the owners and veterinarians observations and also that a dog that is outside is more difficult to monitor and to observe. This two considerations may skew the results, consequently more studies are needed to study the influence of the environment on UI.

Another factor that it was evaluated in our study was the age. About 69 % of the sample with UI in this study were aged bitches, that were 5 or more years, 20 % were aged between 3-4 years and 11 % were young dogs aged up to 2 years. Our results were in agreement with the results from Bleser (de Bleser et al., 2011) that found an association between USMI and increasing ages of bitches. In addition, Holt et al. pointed that it was unusual to find USMI in young dogs (Holt, 1985). However, in the study performed by Holt et al., there was not a statistically significant correlation between the age and UI.

Regarding the contribution of the onset of puberty to UI, our study did not find a significant correlation between the age of first estrus and the UI predisposition nor between the absence of first heat and the UI predisposition. Furthermore, our study indicated that there is not a correlation between the age of UI onset and sterilization before or after the 1st heat ($p = 0.07$), although 66.6% of bitches in this study were sterilized after the 1st heat. Our results are in disagreement with several previous studies indicating that the age of spaying is a risk factor for onset of UI. In fact, Reichler et al. refered that the UI incidence in bitches spayed after the first heat was twice the incidence of UI in bitches spayed immediately before the first heat (Reichler & Hubler, 2014). Spain (Spain et al, 2004) concluded that spaying puppies with less than 12 weeks should be

avoided as the risk of the UI seems to be increased. In addition, a recent systematic review (Beauvais et al., 2012) suggested that neutering, particularly before the age of 3 months, increased the risk of UI. Nevertheless, our study is in agreement a large case–control study that did not found an increased risk of UI regardless the dogs age at the time of surgery (Reichler & Hubler, 2014).

Another important matter is the time interval between the surgical procedure and the onset of UI. In our study, 71% of bitches developed UI between 0 and 2 years after the surgery which is in agreement with other studies. In fact, the majority of the studies referred that UI onset lingered about 2 and 3 years upon surgery (de Bleser et al., 2011, Muraro & White, 2014, Noël et al., 2010). Nevertheless, UI can occur immediately after surgery or after a few years (Noël et al., 2010). Muraro et al. pointed that UI onset may occur until 12 years after ovariohysterectomy (Muraro & White, 2014).

When was analyzed the contribution of the interval of time after the surgical procedure and the age of the UI onset, we concluded that 44 % of the bitches were 3 or more years of age at the UI onset. This observation is probably associated to the fact that most bitches were subjected to ovariohysterectomy during the first year of age.

The bitches weight when performed OVH, did not suffer much variations, but there were observed a majority of dogs weighing between 10 and 20 kg (37.7%). Most likely there is an increase in this group because there is a predominance of large dogs, and as such, the bitches are heavier at the time of OVH.

The study by Muraro & White indicated that the heavier the dog is at the time of OVH, the greater the likelihood of post surgical complications in the short and the long term (Muraro & White, 2014). Ponglowhapan et al. also stated that heavier bitches had an increased risk of suffering UI than the less heavy, and females that were overweight before OVH had 3.5 greater risk than normal dogs to suffer those risks (Ponglowhapan *et al.*, 2012). It was also found that 46.6% of the bitches showed the first signs of UI with a weight between 20 and 30 kg, supporting the idea that the UI prevails in heavier dogs and the weight may be associated with the UI. However, a statistically significant correlation was not demonstrated and further research is advisable.

Exactly 73.3% of dogs in the present study demonstrated an increase of weight since the time of surgery: the weight increase after OVH is a well-known side effect of surgical procedure. Despite being closely associated with sterilization, weight gain and obesity is a multifactorial problem that should not be associated solely and exclusively to OVH since it also depend on the owner knowledge regarding the type of needs and the appropriate food the bitch should (Gregory, 1994; Kustritz, 2002; Sanborn, 2007). A previous study performed by Holt stated that obese dogs with UI became continent or less incontinent after weight loss (Holt 1987, 1989a). In spite of the importance of this results there are not recent studies supporting this observation. Considering the importance of UI to the bitches and to the owner, further studies are needed to clarify the correlation between reduction of UI and weight loss.

Regarding the contribution of pregnancies to the age of UI onset, a statistically significant correlation between was found in our study ($p<0.001$). However, bitches that had never been pregnant showed signs of UI earlier than bitches that had been pregnant once.

In humans, the fact that the woman has been pregnant one or more times is associated with a higher risk of having UI since pelvic floor muscle injuries occur during labor (Ponglowhapan et al., 2012).

The UI of bitches was classified by the owners as an incontinence that occurs mainly in rest times (66.7%) and more than once a day (69%). However it occurs mainly during day and overnight (69%) and 33% classified IU as grade 3 (reasonable). A statistical significance was found between the UI Time of Day and UI Scale (table 5), showing that bitches that had their incontinent moments either during day as during the night is a more serious incontinence than when the bitch only has their incontinent moments during day or night times. Between Night and day, the incontinence is more severe during the night than during the day. It was also found a statistic significance between the UI frequency and UI scale (table 6), proving that UI is more severe when the incontinence appears every other day, then wen only appears only one time a month.

A positive correlation was found between UI sate and UI occurrence, meaning that was proved that when the bitch is excited, the UI mainly occurs during activity times and that regardless the UI state, the UI occurs mainly during rest times. A previous study states that spayed incontinent bitches show an uncontrolled loss of urine not only while sleeping but also when awake, during rest, and occasionally in a sitting position or on a walk (Adin, 2011).

5. Conclusion

UI is a serious and lifelong pathology that decreases the quality of life of bitch and of the owner. This condition is not yet fully understood. It`s more prevalent in bitches than in male dogs, and more prevalent in neutered bitches. Therefore is thought that this condition is hormonal dependent and multifactorial, being the mainly predisposing factors the breed, race, age and weight.

Hopefully this study will enable the development of new studies in order to include new factors that may influence the UI such as the influence of pregnancy found at the age of onset IU.

In some cases UI is a problem to the physician and to the owner, mostly when the treatment is not successful and in some situations euthanasia comes to apply when there is no availability of the owners to make the necessary basic care successfully in order to maintain live quality, and as so, more studies should be performed in order to better understand this pathology, its prevention and the best treatment option.

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Annexes

ESCOLA UNIVERSITÁRIA VASCO DA GAMA

MESTRADO INTEGRADO EM MEDICINA VETERINÁRIA

Este trabalho insere-se no âmbito de uma recolha de dados para elaboração de uma dissertação de mestrado integrado em Medicina Veterinária realizado na Escola Universitária Vasco da Gama.

INCONTINÊNCIA URINÁRIA NAS CADELAS APÓS OVARIOHISTERECTOMIA

• Gostaria de solicitar a sua colaboração para o preenchimento de um pequeno inquérito que segue em anexo

• Destina-se a proprietários e/ou veterinários de cadelas que tenham incontinência urinária e sejam ovariohisterectomizadas.

•Tem como objetivo a avaliação da população canídea feminina com incontinência após a realização da ovariohisterectomia.

• Os inquéritos preenchidos deverão ser recolhidos por si, na sua clínica e enviados depois para o seguinte endereço: ines.acabado.oliveira@gmail.com

Agradeço desde já a sua colaboração!

INSTRUÇÕES DE PREENCHIMENTO:

• Deverá assinalar as suas respostas com uma X (cruz).

• Deverá responder às perguntas de forma sequencial, excetuando quando existirem instruções noutro sentido.

• Salvo indicações em contrário, deverá assinalar apenas UMA RESPOSTA em cada pergunta.

Muito obrigada pela sua colaboração!

I. Indique-me por favor qual a raça:

A- Beagle……❒
B- Boxer……❒
C- Buldogue Francês……❒
D- Cocker spaniel……❒
E- Golden Retriever……❒
F- Husky Siberiano……❒
G- Jack Russel……❒
H- Labrador……❒
I- Pastor Alemão……❒
J- Pastor Belga……❒
K- Poodle/caniche……❒
L- Pug……❒
M- Rotweiller……❒
N- Shih Tzu……❒
O- Teckel……❒
P- Yorkshire……❒
Q- Indeterminado……❒
R- Outra: _____

II. Qual é a idade atual da cadela?

A. 0-6 meses……❒
B. 6 meses a 1 ano……❒
C. 1- 3 anos……❒
D. 3-6 anos ……❒
E. 6-8 anos……❒
F. 8-10 anos……❒
G. Mais de 10 anos……❒

III- Indique o peso atual da cadela:

A. 1-10 kg ……❒
B. 10-25kg……❒
C. 25-40 kg……❒
D. Mais de 40 kg kg……❒

IV- A cadela, no seu dia-a-dia, encontra-se mais em que tipo de ambiente?

A. Interior (dentro de casa ou varanda) ……❒
B. Exterior (fora de casa, na rua ou quintal)…… ❒
C. Interior e exterior…… ❒

V- Classificaria a cadela como:

A. Muito ativa ……❒
B. Pouco activa……❒

VI- Com que idade surgiu o 1º cio? Falta a opção esterilizada antes do 1ºcio

A. 4 -5 meses ……❒
B. 6-7 meses……❒
C. 8-9 meses……❒
D. 10-11 meses……❒
E. 12-13 meses……❒
F. 14-15 meses……❒
G. 16-17 meses……❒
H. 18-19 meses……❒
I. Mais de 19 meses……❒

VII- <u>Antes da esterilização</u> a cadela demonstrava sinais de incontinência urinária?

A- Sim……❒
B- Não……❒

VIII- Se respondeu afirmativamente à questão <u>VII</u>, por favor indique com que idade iniciou a ter sinais de incontinência urinária:

A- 0-6 meses……❒
B- 6 meses a 1 ano……❒
C- 1- 3 anos……❒
D- 3-6 anos ……❒
E- 6-8 anos……❒
F- 8-10 anos……❒
G- Mais de 10 anos……❒

IX- Se respondeu afirmativamente à questão <u>VII,</u> por favor indique com que peso iniciou a ter sinais de incontinência urinária:

A- Menos de 1 kg……❒
B- 1-5 kg ……❒
C- 5-10kg……❒
D- 10-15 kg……❒
E- 15-20 kg……❒
F- 20-25 kg……❒
G- 25-30 kg……❒
H- 30-35 kg……❒
I- 35-40 kg……❒
J- Mais de 40 kg……❒

X- Com que idade realizou a esterilização?

A. 0-6 meses.....❒
B. 6 meses a 1 ano.....❒
C. 1- 3 anos.....❒
D. 3-6 anos .....❒
E. 6-8 anos.....❒
F. 8-10 anos.....❒
G. Mais de 10 anos.....❒

XI- Qual o peso da cadela quando realizou a esterilização?

A. Menos de 1 kg.....❒
B. 1-5 kg .....❒
C. 5-10kg.....❒
D. 10-15 kg.....❒
E. 15-20 kg.....❒
F. 20-25 kg.....❒
G. 25-30 kg.....❒
H. 30-35 kg.....❒
I. 35-40 kg.....❒
J. 40-45 kg.....❒
K. Mais de 45 kg.....❒

XII- Indique, por favor, se desde a esterilização, houve ganho de peso:

A- Não.....❒
B- Sim.....❒
B.1- 0-2kg.....❒
B.2- 2-4kg.....❒
B.3- 4-6kg.....❒
B.4- 6-8kg.....❒
B.5- Mais de 8kg..... ❒

XIII- Qual o motivo da realização da esterilização?

A. Prevenção de patologias reprodutivas.....❒
B. Por problemas comportamentais.....❒
C. Para evitar cios indesejados .....❒
D. Para evitar gestações .....❒

XIV- Após a cirurgia (dias, meses ou anos) a cadela apresentou sinais de incontinência urinária?

A. Sim ……..❒
B. Não……..❒

(Se respondeu afirmativamente a questão anterior, por favor, continue a responder ao restante questionário).

XV- Com que idade começou a ter sinais de incontinência urinária após a esterilização?

A. 0-6 meses……..❒
B. 6 meses a 1 ano……..❒
C. 1- 3 anos……..❒
D. 3-6 anos ……..❒
E. 6-8 anos……..❒
F. 8-10 anos……..❒
G. Mais de 10 anos……..❒

XVI- Com que peso começou a ter sinais de incontinência urinária?

A. Menos de 1 kg……..❒
B. 1-5 kg ……..❒
C. 5-10 kg……..❒
D. 10-15 kg……..❒
E. 15-20 kg……..❒
F. 20-25 kg ……..❒
G. 25-30 kg……..❒
H. 30-35 kg……..❒
I. 35-40 kg……..❒
J. 40-45 kg……..❒
K. Mais de 45 kg……..❒

XVII- A incontinência urinária ocorre:

A. Várias vezes ao dia……..❒
B. Uma vez por dia ……..❒
C. Dia sim dia não……..❒
D. Uma vez por semana……..❒
E. De quinze em quinze dias……..❒
F. Uma vez por mês……..❒

XVIII- A incontinência urinária ocorre mais quando a cadela se encontra em:

A. Repouso……❒
B. Atividade……❒

XIX- Em que altura do dia é que ocorre a incontinência urinária?

A. Durante o dia……❒
B. Durante a noite……❒
C. Ambos……❒

XX- A incontinência ocorre quando a cadela se encontra num estado:

A. Submisso……❒
B. Excitado……❒
C. Ambos……❒

XXI- Como classificaria a incontinência urinária numa escala de 1 a 5?

A. 1 (muito pouco grave) ……❒
B. 2 (pouco grave) ……❒
C. 3 (razoável) ……❒
D. 4 (grave) ……❒
E. 5 (muito grave) ……❒

Muito obrigada pela sua colaboração!

Inês Oliveira

Inês Oliveira

Table 9 – Characteristics of the collected data collected data

Factors	Category	Response	%
Size	Small	10	22.2%
	Medium	15	33.3%
	Large	20	44.4%
Type of fur	Short and smooth	34	75.5%
	Long and smooth	4	8.8%
	Short and wavy	1	2.2%
	Long and wavy	2	4.4%
	Short and bristly	2	4.4%
	Medium and smooth	2	4.4%
Tail docking	Yes	9	20%
	No	36	80%
Environment	Exterior	5	11.1%
	Interior	24	53.3%
	Both	16	35.5%
1st heat age	6-7 months	16	35.5%
	8-9 months	14	31.1%
	Never had heat	15	33.3%
Estric cycles	0 cycles	15	33.3%
	1-3 cycles	15	33.3%
	5-11 cycles	6	13.3%
	More than 11 cycles	9	20%
Age at OVH	0-5 months	10	22.2%
	6 months-1 year	13	28.8%
	1-6 years	12	26.6%
	More than 6 years	10	22.2%
Age at UI	0-3 years	20	44.4%
	3-8 years	17	37.7 %
	More than 8 years	8	17.7%
Time until UI after OVH	0-2 years	32	71.1%
	3-6 years	9	20%
	More than 6 years	4	8.9%
Weight at OVH	1-10kg	12	26.6%
	10-20kg	17	37.7%
	20-30kg	14	31.1%
	More than 30kg	2	4.4%
Weight gain since OVH	1-3kg	14	31.1%
	More than 3kg	19	42.2%
	0kg	12	26.7%
Weight at UI	1-10kg	10	22.2%
	10-20kg	7	15.5%
	20-30kg	21	46.6%
	30-40kg	7	15.5%
Pregnancies	Yes	10	22.2%
	No	35	77.8%
UI frequency	Several times a day	24	53.3%
	One time a day	7	15.5%
	Every other day	6	13.3%
	One time a week	2	4.4%
	One time a month	6	13.3%
UI time of day	Day	5	11.1%
	Night	9	20%
	Both	31	68.9%
UI ocorrency	Both	8	17.7%
	Activity	7	15.6%
	Rest	30	66.7%
UI state	Submissive	8	17.7%

	Excited	6	13.3%
	Both	31	68.9%
UI scale	1	3	6.7%
	2	10	22.2%
	3	15	33.3%
	4	14	31.1%
	5	1	2.2%
Treatment	Yes	29	64.4%
	No	16	35.6%